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published in

Strategic Entrepreneurship Journal
2015

DOI (link to publisher)

[10.1002/sej.1201](https://doi.org/10.1002/sej.1201)

[Link to publication in VU Research Portal](#)

citation for published version (APA)

Reymen, I. M. M. J., Andries, P., Berends, J. J., Mauer, R., Stephan, U., & van Burg, J. C. (2015). Understanding dynamics of strategic decision-making in venture creation: a process study of effectuation and causation. *Strategic Entrepreneurship Journal*, 9(4), 351-379. <https://doi.org/10.1002/sej.1201>

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UNDERSTANDING DYNAMICS OF STRATEGIC DECISION MAKING IN VENTURE CREATION: A PROCESS STUDY OF EFFECTUATION AND CAUSATION

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This study draws upon effectuation and causation as examples of planning-based and flexible decision-making logics and investigates dynamics in the use of both logics. The study applies a longitudinal process research approach to investigate strategic decision making in new venture creation over time. Combining qualitative and quantitative methods, we analyze 385 decision events across nine technology-based ventures. Our observations suggest a hybrid perspective on strategic decision making, demonstrating how effectuation and causation logics are combined and how entrepreneurs' emphasis on these logics shifts and re-shifts over time. We induce a dynamic model that extends the literature on strategic decision making in venture creation. Copyright © 2015 Strategic Management Society.

INTRODUCTION

The process of new venture creation is characterized by the need to decide and take action in the face of uncertainty (e.g., Alvarez and Barney, 2005; McMullen and Shepherd, 2006; Sarasvathy, 2001), and this is particularly the case for technology-based

ventures. The nature and outcome of their technology development activities, as well as market selection and commercialization processes, are not just risky but inherently unpredictable and fraught with 'ambiguity' or 'Knightian uncertainty' (Chesbrough, 2003; Steensma *et al.*, 2000; Utterback, 1987). Alvarez and Barney (2005) and Alvarez (2007) explain that this uncertainty makes it difficult for the entrepreneur to know how to organize the emerging venture (such as deciding how to assign the residual profits of an opportunity and making decisions about acquiring and coordinating resources). They argue that we need a better understanding of the decision-making tools entrepreneurs use to

Keywords: decision making; effectuation; new venture creation; uncertainty; process research

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organize ventures in such uncertain contexts. We focus on this important mechanism, i.e., entrepreneurial decision-making logics, and contribute more broadly to understanding the role of strategic decision making in the venture creation process under conditions of uncertainty.

The entrepreneurship literature describes several approaches to decision making in the face of uncertainty, including approaches that stress planning and control (e.g., Brinckmann, Grichnik, and Kapsa, 2010; Delmar and Shane, 2003; Miller and Cardinal, 1994) and approaches that emphasize more flexible, adaptive, and collaborative decision making, such as improvisation (e.g., Baker, Miner, and Eesley, 2003), bricolage (Baker and Nelson, 2005), and effectuation (Sarasvathy, 2001). However, planning-based approaches appear to have limited success in contexts characterized by true uncertainty, as plans based on past predictions often no longer accurately reflect the unfolding course of events in such contexts (Alvarez and Parker, 2009; Brinckmann *et al.*, 2010; Chwolka and Raith, 2012; Dencker, Gruber, and Shah, 2009; Gruber, 2007). In contrast, more flexible, experimental, and adaptive approaches appear to fit better with uncertain decision-making contexts (Alvarez and Parker, 2009; Andries, Debackere, and Van Looy, 2013). It has been suggested that venture creation benefits from a planning-based approach in the absence of uncertainty, while collaborative, flexible decision making is crucial for venture creation under uncertainty (Alvarez and Barney, 2005; Sarasvathy 2001). In uncertain contexts, decision making needs to be adaptive over time and responsive to the change and instability inherent in such contexts. So far, however, no research has explored how decision-making logics are used over time, how they may shift over the course of the venture creation *process*, and what specific conditions might trigger such shifts (e.g., Alvarez, Barney, and Anderson, 2013; Read and Dolmans, 2012). The current study addresses this gap by shedding light on whether, how, and why decision-making logics might be alternated or combined (i.e., adapted) over time.

As we have discussed, several planning-based and flexible decision-making logics exist. This study specifically focuses on causation and effectuation (Sarasvathy, 2001) as examples of a planning and a flexible decision-making logic. Causation and effectuation have gained increasing interest in the strategic entrepreneurship literature, have been articulated in relation to each other, and imply a process focus.

An effectual decision-making logic, in contrast to a causal one, describes how entrepreneurs actively engage uncertainty by being responsive to information and feedback and by leveraging existing means and stakeholder contacts that may change over time (Read, Song, and Smit, 2009b; Sarasvathy, 2001; Wiltbank *et al.*, 2006). As is the case for planning-based and flexible decision-making logics in general, our understanding of how effectual and causal decision-making logics evolve over time is still underdeveloped, as is our knowledge of what drives the use of either logic at a given time (Arend, Sarooghi, and Burkemper, forthcoming).

A process approach is needed for a more comprehensive explanation of entrepreneurial decision making in venture creation. Not only do strategic entrepreneurial decisions shape a venture over time, but also the conditions that may impact decision making evolve during the venture creation process. As decision-making logics are context dependent (Alvarez and Barney, 2005; 2007) and the context—in particular the level and type of uncertainty—changes over time, entrepreneurs are likely to shift from one logic to another or to combine different logics (Read and Sarasvathy, 2005). Restricting the explanation of the drivers of decision-making logics to initial conditions obscures how entrepreneurs act upon such conditions, react to perceived changes, and shape their own processes (e.g., McMullen and Dimov, 2013). A process approach also helps to move beyond the discussion of causation and effectuation as competing approaches to decision making. It can shed light on whether, how, and why decision-making logics might be alternated or combined, thereby also increasing the understanding of the relationship between decision-making logics in the venture creation process.

This study adds a longitudinal process approach (Langley, 1999) to the body of research on entrepreneurial strategic decision making under uncertainty. In particular, it addresses the following questions: (1) *How does the use of effectual and causal decision making evolve during the venture creation process?* and (2) *What may drive shifts in the use of effectual and causal decision making?* To answer these questions, we combine qualitative and quantitative methods to analyze 385 decision events across nine technology-based ventures.

Collectively, our findings advance the theoretical understanding of strategic decision making in venture creation processes and add to the literature

on strategic decision making under uncertainty. First, we contribute a hybrid perspective to the literature on strategic decision making by demonstrating how ventures combine effectual and causal logics in key decisions along the development process (rather than using one or the other logic exclusively) and how the emphasis in the use of the logics shifts over time. Second, we advance a novel, dynamic model of what drives entrepreneurs' strategic decision making, thereby extending the literature on planning-based and flexible decision-making approaches in venture creation. Our findings support and extend Alvarez and Barney's (2005) work by showing that perceived changes in external and venture conditions (including uncertainty, but also resource position and stakeholder pressures) lead to shifts in the use of decision-making logics. Third, we add to the emerging literature on venture scoping by highlighting the mediating role of venture scoping between perceived venture conditions and the use of strategic decision-making logics. Thus, scoping decisions are immediate conditions influencing the use of strategic decision-making logics in venture creation processes. We define the scope of a venture as the set of technologies, product offerings, or markets that the entrepreneurs consider or target at a particular moment in time.

THEORETICAL BACKGROUND

Decision making under uncertainty

Entrepreneurial firms 'are organized under conditions of uncertainty, and their primary purpose is to solve transaction difficulties associated with the inability to know the value of an exchange at the time that exchange is commenced,' as Alvarez and Barney (2005: 788) state. Uncertainty—in contrast to risk—refers to an unspecific and unpredictable context, i.e., outcomes that can neither be foreseen nor linked to probabilities in *a priori* decision-making processes. More specifically, uncertainty is defined as a lack of knowledge and, therefore, an inability to predict a state, effect, or response of the environment relative to the venture's own actions (McKelvie, Haynie, and Gustavsson, 2011; Milliken, 1987). It dominates decision making in the early venture stage and weighs even more heavily for technology-based ventures, where both the technology and the market are sources of uncertainty (Atuahene-Gima and Haiyang, 2004).

A key difference between entrepreneurial and non-entrepreneurial decision making is that entrepreneurial decision making happens in uncertain environments, whereas non-entrepreneurial decision making takes places under conditions of risk (Alvarez and Barney, 2005). As entrepreneurial decision making is a key element of a successful organizing process under uncertainty, the question arises as to which decision-making tools or logics to use under these conditions. Traditionally, analysis and planning are seen as means to reduce uncertainty. For instance, Anderson and Tushman (2001: 683, *italics added*) find that technology ventures 'try to fit themselves to the environments they *expect* to encounter.' Alvarez and Barney (2005) propose that planning-based causal decision making is useful when data and information are abundantly available and reliable. Under such conditions, decision making is consistent with transaction costs economics, as information is available to assign residual rights and to take other important venture organizing decisions. However, how the market will develop often depends on many decisions by various actors, and clarity will exist only after the fact, i.e., after entrepreneurial activities have shaped an industry's development (Dutta and Crossan, 2005). When there is no or limited reliable information about the future, the effectiveness of prediction and planning in such highly uncertain settings appears to be limited (Brinckmann *et al.*, 2010; Chwolka and Raith, 2012; Gruber, 2007). Instead, a collaborative, flexible decision-making approach is expected to benefit venture creation processes under uncertainty (Alvarez and Barney, 2005).

One such flexible, adaptive decision-making logic is effectuation, as an alternative to causation, which is a planning-based decision-making logic (Sarasvathy, 2001). In contrast to causation, effectuation actively embraces uncertainty and increases control through co-creative processes that start from existing means and accumulate commitments (and resources) which, in turn, allow ideas to converge and specific goals to emerge (Sarasvathy and Dew, 2005). We draw on the distinction between effectuation and causation as specific decision-making logics because it emerged in the field of entrepreneurship (Sarasvathy, 2001), has developed into an established perspective and has proven its value in broader domains including strategy (Wiltbank *et al.*, 2006) and innovation (Berends *et al.*, 2014; Brettel *et al.*, 2012). Further, effectuation and causation are processual concepts, thus fitting our process research

approach. Finally, the conceptualization of effectuation and causation is especially useful because these decision-making logics are articulated in a balanced way by differentiating them systematically on a set of underlying dimensions. This facilitates empirical research into the relative use of these logics in venture creation processes.

Effectual and causal decision-making logics

Effectual and causal decision making are commonly differentiated along four dimensions or principles, although their precise character can vary slightly across publications (Brettel *et al.*, 2012; Chandler *et al.*, 2011; Dew *et al.*, 2009; Fisher, 2012; Sarasvathy, 2001). We follow the theoretical exposition that effectuation reduces uncertainty through emphasizing control—as opposed to emphasizing prediction in causation—and, thus, that effectuation and causation can be contrasted on four decision-making principles regarding: (1) the basis for taking action; (2) the attitude toward unexpected events; (3) the attitude toward outsiders; and (4) the view on risk and resources. Thus, we follow most closely the approach of Dew *et al.* (2009), while also taking into account the approaches of Chandler *et al.* (2011) and Brettel *et al.* (2012).

Basis for taking action

The overall logic of how one arrives at the decision to act differs fundamentally for effectuation versus causation. Causation takes a certain goal or effect as a given and focuses on selecting the means to reach that effect; this is like cooking based on a recipe. Under a causal logic, entrepreneurs or venture teams start by setting a goal. They subsequently map the environment by analyzing competitors, market trends, and perceived competitive advantage. Based on this analysis, they devise a strategic plan to mobilize the right resources to achieve the set goal (e.g., Brinckmann *et al.*, 2010; Miller and Cardinal, 1994). In contrast, effectuation takes the set of individual means available to the venture as the starting point for decision making and focuses on working toward possible effects that can be created with these means; this is like opening a refrigerator and creating a dish with the given ingredients (Sarasvathy, 2001; Sarasvathy and Dew, 2005).

Attitude toward unexpected events

Effectual and causal logics differ in the way entrepreneurs or venture teams react to their market

environment and deal with unforeseeable events. Causation aims to carry out a strategy as planned, negatively reacting to any unexpected events that may arise, which are seen as interruptions to the execution of the strategy (Garud and Van de Ven, 1992; Van de Ven and Polley, 1992; Choi, Lévesque, and Shepherd, 2008). Effectuation, in contrast, is an adaptive feedback-seeking and feedback-incorporating process. This adaptability keeps effectual decision making sufficiently open to be able to leverage unexpected events for the benefit of the venture (Chandler *et al.*, 2011).

Attitude toward outsiders

The two logics also differ with regard to how the focal venture interacts with and involves other people and organizations in the venture creation process. Entrepreneurs utilizing a causal logic tend to protect knowledge from outsiders, using it to build their competitive advantage, for instance through developing dedicated intellectual property protection strategies (Chesbrough, 2006). If they partner with other ventures, then such alliances are planned for, partners are carefully selected based on complementary competencies to fulfill the focal organization's goals, and alliance contracts judiciously specify responsibilities (e.g., Read *et al.*, 2009a). The literature on strategic alliances exemplifies this causal tradition (e.g., Walter, Kellermanns, and Lechner, 2010). In contrast, under an effectual logic, venture creation processes are open for, and indeed contingent on, the involvement of other people and organizations as committed stakeholders. Stakeholders bring access to resources, but at the same time also reduce uncertainty and shape the very goals and direction of the venture (Read *et al.*, 2009a). Draft products, for example, are exposed to potential clients to elicit feedback and potentially attract new stakeholders.

View on risk and resources

The two logics also differ fundamentally with regard to the size and flexibility of investments sought and made. A causal approach is based on a well-defined business plan and typically seeks large investments that allow maximizing expected returns, based on the calculation of different possible scenarios. In contrast, effectuation highlights the inherent unpredictability of the environment. Rather than asking investors and founders to invest as much as possible to maximize potential future returns, the

focus is on the current situation and on assets under the control of investors and founders. Investments should be no larger than what each individual can afford to lose (Dew *et al.*, 2009). This means that typically ‘small step’ investments are made, and available resources in the local environment are mobilized or repurposed (cf. ‘bootstrapping,’ e.g., Bhide, 1992; Winborg and Landström, 2001).

Opposing, independent, or compatible logics?

Effectuation and causation are often introduced as opposing decision-making logics. However, they may not have to be mutually exclusive (Sarasvathy, 2008). In fact, it could be that optimal decisions result from a combination of both logics, where the causal logic ensures that the venture stays focused and predicts what is predictable, while effectual decision making allows responding flexibly to changing circumstances and maintaining hands-on control over uncertain aspects of the venture.

Empirical evidence on how effectuation and causation relate to each other is scarce and conflicting. Some studies find evidence that individual entrepreneurs may combine both logics (Sarasvathy, 2008; Dew *et al.*, 2009; Fisher, 2012), while other studies conceptualize them as polar opposites (Brettel *et al.*, 2012; Corner and Ho, 2010), and still other researchers suggest they may be largely independent of each other (Chandler *et al.*, 2011; Perry, Chandler, and Markova, 2012). Yet, to advance research on strategic decision making in venture creation processes, we need to develop a robust understanding of our key concepts (Arend *et al.*, forthcoming; Perry *et al.*, 2012), which include the relationship between effectuation and causation and how they may evolve over time.

Effectual and causal decision making over time

Prior research on effectuation and causation has investigated the degree to which these logics are used, both in experimental studies (e.g., Sarasvathy, 2008; Dew *et al.*, 2009; Read *et al.*, 2009a), single-shot surveys (e.g., Chandler *et al.*, 2011; Brettel *et al.*, 2012; Politis, Winborg, and Dahlstrand, 2012), and field studies (e.g., Corner and Ho, 2010; Fisher, 2012), but always at a single moment in time or by treating the whole entrepreneurial journey as a single observation (see Perry *et al.*, 2012, for a review). In these cross-sectional studies, differences in the use of effectuation and causation have been

explained by initial founding conditions, primarily entrepreneurial experience (e.g., Dew *et al.*, 2009; Politis *et al.*, 2012), and uncertainty due to the novelty of the market or the radicalness of an innovation (Sarasvathy, 2008; Brettel *et al.*, 2012).

It is surprising that no research to date has investigated potential shifts in the use of these logics over time. This is especially true given that effectuation theory proposes endogenous, path-dependent processes which, in addition to variation in perceived uncertainty, lead to variation in the use of effectuation and causation over time (e.g., Sarasvathy, 2008; Wiltbank *et al.*, 2006). The lack of process research on effectuation means that our understanding of the conditions influencing the use of effectuation and causation is still underdeveloped.

Despite the absence of empirical research, a conjecture with regard to such longitudinal dynamics can be distilled from prior research and theory. Effectual and causal logics may be particularly suitable for specific development phases in a venture’s lifetime, such as the use of effectual decision making during venture start-up when uncertainty is arguably particularly high (e.g., Alvarez and Barney, 2005; McMullen and Shepherd, 2006; Sarasvathy 2008). Once the venture expands and endures over time, it is more likely to grow through causal decision making. Similarly, research found planning to be relatively less effective in young, small ventures (Brinckmann *et al.*, 2010).

Taken together, these arguments suggest that a process research approach (Langley, 1999) can help to gain a more comprehensive understanding of entrepreneurial decision making. A process approach focuses on longitudinal dynamics. Thus, it allows us to explore patterns of effectuation and causation over the course of a venture’s development and to examine drivers of effectuation and causation beyond initial conditions. This approach pays tribute to entrepreneurship as a process that involves self-regulation and agency, where entrepreneurs act upon initial conditions, react to perceived changes, and shape their ventures’ development process (cf. McMullen and Dimov, 2013; Wiltbank *et al.*, 2006).

RESEARCH METHODS

Research approach

Adopting a process research approach (Langley, 1999), we analyzed nine technology ventures

in-depth. We documented these ventures' development processes as a sequence of decision events 'that describe how things change over time' (Van de Ven, 2007: 197), with the aim of analyzing these decision event lists for the use of effectual and causal decision-making logics and their potential influencing conditions. Our multiple case study design enabled us to analyze both within-case variation over time and cross-case variation (Gerring, 2007).

Case selection

Because our aim was to extend theory on decision-making dynamics in venture creation, we used purposeful sampling to select cases by seeking information-rich cases that facilitate theoretical inference (Gerring, 2007; Eisenhardt and Graebner, 2007). The selected cases had to be similar with respect to several criteria. First, all ventures had to be founded in the same geographical region, facing highly similar institutional contexts. All cases originated in the Eindhoven-Leuven-Aachen triangle (ELAt), a geographical area in the Dutch, Belgian, and German cross-border region where high-technology, knowledge-based industries account for 20 percent of regional GDP. The region is characterized by cross-border networks and support activities, including cross-border business parks and cross-border entrepreneurial education initiatives. Second, the ventures in our study had to be active in high-technology industries and engage in developing new technology, as we wanted to study ventures that faced substantial uncertainty. The nature and the outcome of such ventures' technological activities, as well as their market selection and commercialization processes, are inherently unpredictable and characterized by ambiguity. A third selection criterion was that the ventures allowed the collection of detailed information on the development of decision-making logics over a longer time span, from early emergence stages up to the phase in which they generated business. Although the ventures differed in age, they had all gone through similar phases in their development path.

Within the limits of these three criteria, we applied maximum variation sampling to find 'important shared patterns that cut across cases and derive their significance from having emerged out of heterogeneity' (Patton, 2002: 235). We included cases that differed with regard to the two main conditions influencing the use of effectual and causal decision making identified in the literature to date: level of

experience and level of uncertainty (represented by varying levels of market newness; all cases faced technological uncertainty). Thus, we selected: (1) cases where founders had extensive entrepreneurial experience, as well as cases with moderate or low entrepreneurial experience (Sarasvathy, 2008); and (2) ventures that targeted new markets with new technologies and ventures that targeted existing markets with new technologies (Sarasvathy and Dew, 2005).

Taken together, maximum variation sampling led to diversity among cases. This increased the likelihood of selecting cases that displayed variety in the use of effectuation and causation logic over time, enabling more robust theory development (Eisenhardt and Graebner, 2007). Moreover, by limiting our selection to ventures that were active in high-tech sectors and that originated in the same geographical region, we ensure that observed differences in effectual or causal decision making are not due to sectoral or regional differences. The ventures were all founded by teams consisting of two to four entrepreneurs who also represent their initial employee bases. Table 1 and Table 2 summarize the nine cases.

Data collection

We conducted interviews with multiple respondents and collected archival documents to triangulate information (Yin, 2009). Data was collected from January to September 2010. Table 1 summarizes the data for each case.

First, we conducted a total of 56 semi-structured interviews, which lasted on average 1.5 hours and were conducted by one to three interviewers. We interviewed members of the entrepreneurial teams who founded the venture. In all cases, we interviewed at least one of the founders who was active in the venture during the entire period covered. To triangulate entrepreneurs' reports, we also interviewed other important stakeholders including key employees, investors, key customers, board members, and university technology transfer officers among others. Interviewees first elaborated on their role in the venture and described the development trajectory of the venture. Subsequent interview topics included founding team and employees, products/services and innovation, clients, revenues, investments, competition and industry, intellectual property, location and facilities, future, and sustainability. Each interview was recorded and transcribed.

Table 1. Case characteristics

Case	Industry	Existing or new product and market ^a	Entrepreneurial experience of founders ^b	Period covered	Events	Inter-views	Archival documents
<i>SunCo</i>	Solar	NEW product, EXISTING market	HIGH: Two founders with venture experience	1997–2010	50	9	63
<i>ChipCo</i>	Telecom	NEW product, EXISTING market	MODERATE: One founder with industry and managerial experience, three inexperienced founders	2000–2003	36	9	54
<i>TextCo</i>	Telecom	New product, NEW market	LOW: Two founders with almost no experience (fresh graduates)	1999–2010	49	10	32
<i>DataCo</i>	Information technology	New product, NEW market	LOW: Two PhD students with experience only in university-industry projects	1998–2004	45	5	130
<i>NeuroCo</i>	Information technology	New product, EXISTING market	MODERATE: Three founders with no entrepreneurial experience (professor, PhD students); one with consulting experience	1997–2002	38	8	5
<i>AppleCo</i>	Agriculture	New product, EXISTING market and new product, NEW market	HIGH: One founder with industry, venture, and managerial experience; one without entrepreneurial experience	1982–2010	45	4	130
<i>EnergyCo</i>	Green energy	New product, NEW market	LOW: Three PhDs; one with industry experience	1996–2010	48	6	55
<i>WaterCo</i>	Green energy	New product, EXISTING market	LOW: Two students with almost no experience (fresh graduates)	1999–2010	42	3	10
<i>TravelCo</i>	Information technology	New product, NEW market	MODERATE: Two PhD students (one with some managerial experience, another with some venture experience)	2005–2010	32	2	15

^a A market is classified as 'new' if the type of product/service that the firm offers has not been previously available in that market or because the type of product/service enters a new geography or new market segment (based on Sarasvathy and Dew, 2005).

^b The rating of the founders' entrepreneurial experience is based on the assessment of the degree of prior venture, managerial, and industry experience as 'high,' 'moderate,' and 'low.' The final rating per case is determined by classifying founders with high prior venture experience as high and founders with moderate or high managerial and industry experiences as moderate.

Table 2. Short case descriptions

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- SunCo:** In early 2000, the founders of a small energy company and of a multinational glass company combine forces to start a company in the solar panel industry. They adopt a dual strategy, funded by their private capital. One founder sets out to build a project-based business using standard available products, while the other commits to large up front investments in a radically new solar technology. The project-based business grows steadily over time and expands internationally. Meanwhile, the technology development process is behind schedule and going over budget. As the economic crisis hits in 2008, the company experiences liquidity problems. The company devises alternative strategies.
- ChipCo:** After being approached by a VC firm in 2000, a professor and PhD student start, with the help of an outside CEO with extensive telecom experience, a company based on their optical chip technology. During the product development phase of their first product, the telecom industry crashes. Confident in their capabilities, the team continues. However, potential clients fail to purchase the product, as it demands a total redesign of their systems. In need of cash, the team quickly develops a second, more marketable product and starts looking for additional funding and for other applications and markets for their technology. With no other options left, the company is taken over.
- TextCo:** During their industrial engineering program in 1999, two students decide to try sending text messages (SMS) as an advertising tool for a local nightclub. They collect phone numbers of people entering nightclubs and use their university laptops and their parents' Internet connections to send the messages. When proven successful, the students start their company and soon offer SMS services to other types of businesses, like logistics firms. The founders try to introduce new products in the new market created by the availability of SMS technology and even open a new office abroad to reach new customers there.
- DataCo:** In 1999, three doctoral students decide to commercialize their research on neural network technology in a new spin-off. DataCo initially serves three previously non-existing market segments with customized software. In 2001, two markets are dropped and DataCo decides to offer high-end state-of-the-art customer intelligence solutions to, among others, financial/insurance companies. The chosen focus soon proves fruitful, as the terrorist attacks of 9/11 lead to stricter regulations, forcing financial institutions to take security measures. In 2002, DataCo starts to internationalize and merges in 2004 with an established international firm to support its international expansion.
- NeuroCo:** In 2000, NeuroCo is founded as a spin-off, with the aim of developing and commercializing software solutions using a neural network-based algorithm developed at the university. The first year is spent on developing software and executing IT consulting projects to generate some income. In early 2001, all efforts are directed at commercializing the software product and consulting activities are abandoned. NeuroCo has huge problems in obtaining market credibility. It turns out to be impossible to compete with big players. In July 2002, NeuroCo decides to end the NeuroCo story: the patents and algorithms are sold to a software provider, and NeuroCo ceases to exist.
- AppleCo:** Since 1982, the owner of an apple tree nursery and the research director of a university's fruit breeding center had jointly developed several new apple varieties. In 2000, they found AppleCo, with the goal of licensing new varieties through traditional methods as well as molecular breeding methods, thereby targeting an emerging market segment. Molecular breeding is reduced in 2001 and abandoned in 2004. AppleCo's business model is innovative, involving a 'club' with members from each step in the industry's value chain. It allows AppleCo to successfully commercialize three new apple varieties in a shrinking industry.
- EnergyCo:** Founded in 1996 by two students, EnergyCo was considered a successful company operating in the renewable energy industry. Due to regulatory changes, for example reductions in the feed-in tariffs for the European renewable energy market, and also as a consequence of its fast growth, EnergyCo is facing a variety of challenges by 2010. The two founders are moving in the direction of power producers. A supply-side new market emerges: creating joint ventures between EnergyCo and local energy suppliers creates individual distribution channels for B2B and B2C business.
- WaterCo:** In 1999, three technical engineers invented a new product to the existing market of clean sewage water. They filed for patents for their inventions, founded their company WaterCo, and in 2000 received financial support from different start-up support programs and later acquired venture capital. In December 2003, the company received its first major order. In January 2004, a lawsuit alleging multiple infringements of intellectual property rights threatened the company's very existence. WaterCo ended up being bought by another large competitor.
- TravelCo:** In 2007, TravelCo started out as a university spin-off to replace inefficient and time-consuming search-and-compare processes for passenger transport with new technology on the Internet. It enables people to perform comprehensive searches including all relevant transport modes. The Internet platform and the founding team demonstrated successfully that their concept worked in their home market in 2009. However, by August 2010, TravelCo faced the threat of competition from new market entries backed by big Internet players. TravelCo's founders were forced to consider expanding internationally.
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Second, we triangulated interview data with archival documents, which also helped counterbalance potential retrospective bias in interviewee reports (discussed later). The 494 archival documents consisted of annual reports, strategic planning documents, patents, company presentations, newspaper articles, Web articles, and public interviews.

Data coding

We coded the data in two steps: we first created a list of key decision events in the development of each venture and then coded each of the events for effectuation and causation.

Creation of decision event lists

We used the iterative procedures developed by Van de Ven and Poole (1990) and Poole *et al.* (2000) to identify key *decision events* using information from the interviews and documents (similar to, for example, Jain and Sharma, 2013). Decision events were defined as actions or decisions taken by the entrepreneurial teams in creating the venture. Thus, we took the perspective of the members of the entrepreneurial team in the identification of decision events, and the decision events had to involve their intentionality. Examples are: introducing a first product idea, contacting a potential customer, acquiring funding, initiating collaboration with a supplier, deciding about new production facilities, and hiring an employee. Decisions by other stakeholders, such as venture capitalists and customers, were not coded as decision events. We coded conservatively, meaning that we coded only what was explicit in the data and did not infer intentionality. Decision events had to be significant, i.e., they had to have a *potential* important impact on the venture creation process. To void success bias, the resulting impact was not considered to be part of the decision event itself. Past research shows that individuals recall significant decision events well and accurately (Chell, 2004). To mitigate potential retrospective bias, we included only decision events mentioned by at least one of the founders—who we consider key informants (Huber and Power, 1985)—and by at least one other source (e.g., interviews and/or documents). This way we tapped into potential differences in perspectives and emotional involvement, so that biases or lapses in the founder's report were likely to be offset by other informants (Golden, 1992; Huber and Power, 1985).

For each decision event, we recorded its time of occurrence, creating chronologically ordered *decision event lists*. Past research demonstrates that the creation of event lists ensures particularly accurate and complete retrieval of retrospective reports (Belli, 1998). For each event, we also coded to which *venture creation phase* it belonged, using the four phases described by Clarysse and Moray (2004)—idea phase, pre-start-up, start-up, and post-start-up phase—as an analytic tool.¹

Decision events were identified by at least two researchers who had collected the data for a particular case. These researchers independently examined information from the data sources to identify events. There were very few disagreements about events and their interpretation. These disagreements were first discussed between the researchers and if they could not be resolved, the event was discussed by the entire team of six researchers to ensure consistent interpretation of events (Van de Ven and Poole, 1990). QSR Nvivo software was used to maintain a chain of evidence between raw data and decision event descriptions. The final decision event lists for each case contained from 32 to 50 decision events per case (385 decision events in total) and enabled us to consider single decision events as well as their longitudinal implications (Langley, 1999).

Coding for effectuation and causation

Building on studies like Chandler *et al.* (2011), Read *et al.* (2009b) and Fisher (2012), we considered effectual and causal decision making at the level of ventures by focusing on decisions taken by the entrepreneurial teams for the ventures and not at the level of individuals. As explained in the theoretical background, we follow Dew *et al.* (2009) in differentiating effectuation and causation on four dimensions. To be able to gauge whether effectuation and causation may co-occur, we follow Chandler *et al.* (2011) and treat effectuation and causation as independent constructs. We created a balanced coding scheme consisting of two theoretical categories based on effectuation and causation theory, i.e., one

¹ Events taking place before the decision to start-up a company were categorized in the idea phase. Events after this decision but before the formal legislation of the company were categorized in the pre-start-up phase. The formal legislation of the company and subsequent events up until the shift from technological development to generating business were categorized in the start-up phase. All decision events representing this latter shift and subsequent events were categorized in the post-start-up phase.

effectuation and one causation category, with four dimensions for each category (see Table 3). For each of these dimensions, we created a set of empirical indicators, iterating between the literature (especially Read *et al.* (2009a), Dew *et al.* (2009), and Sarasvathy (2008)) and our empirical data.

Specifically, we developed the coding scheme in four steps. First, all six coders contributed to an initial collection of empirical indicators based on the literature, which was discussed until consensus was reached on an initial list of codes for empirical indicators, consisting of opposing items for effectuation and causation. Second, each research team coded one of their own cases using this initial list of codes. Discussing the coding results among all teams led to slight changes in the empirical indicators, to resolve inconsistencies, clarify understanding of the indicators, and make sure that they matched the dimensions of effectuation or causation. In a third step, we further aligned the coding process: the authors jointly coded 20 decision events of the same case. Discussions about the differences in coding led to further minor changes in the empirical indicators. In a fourth step, the authors independently coded 20 decision events of each case using the revised final coding scheme consisting of 36 codes for the different empirical indicators. Interrater agreement was high, with 0.83 percent agreement. Table 3 presents the final coding scheme and displays examples of coded events.

In a next step, all decision events were coded by two coders independently. Each event was coded based on the event list in conjunction with the primary interview and document data. This way the coding took the event's connection to prior events into account. Differences between coders were resolved through discussion. To reiterate, each decision event could be coded as corresponding to four effectual and four causal dimensions, thus effectual and causal logics could co-occur in the same decision event. We counted how many effectuation dimensions (potentially ranging from zero to four) and how many causation dimensions (potentially ranging from zero to four) were coded per decision event. In practice, at least one effectuation or causation dimension was coded for each event, and a number of events were coded both for effectuation and causation dimensions. An example of an event coded as both effectuation and causation is SunCo's event 5, which deals with the decision to explore different technologies for developing solar panels using their previously developed glass and coating

knowledge. They made sure that they selected a technology that differentiated them from competitors. This event was coded as effectuation, specifically the means-oriented dimension (based on the empirical indicator 'building on own knowledge base and other available existing own resources,' see Table 3). The event was also coded for the competitive analysis dimension of causation (based on the empirical indicator 'carrying out competitor analysis and competitive positioning').

The number of dimensions coded varied substantially over events, with an average number of 0.79 effectuation dimensions and 0.89 causation dimensions being coded per event. Pearson correlations across events indicated only one significant correlation among the four dimensions of effectuation;² the dimensions of causation were not significantly correlated with each other.

Analysis strategy

Our research design enabled us to investigate both within-case variation over time and cross-case variation (Gerring, 2007). With regard to within-case analyses, the event sequences and their coding were analyzed in-depth using qualitative and quantitative process research procedures (Poole *et al.*, 2000), including event sequence graphs and tabular representations. This helped explore patterns in the use of effectual and/or causal logics over time and get insight into potential conditions driving changes and shifts in the use of these logics. Process research is particularly well suited for identifying such necessary conditions for change (Mohr, 1982). We explain our methods of analysis in more detail together with the results.

ANALYSIS AND RESULTS

Exploration of cross-case and within-case variation

We first explore *cross-case variation* in the use of effectuation and causation. Table 4 shows that all cases used both effectual and causal decision-making logics, although with varying frequency. Past research has focused on initial conditions to explain the usage of effectuation and causation logics, thus we compared the cases with regard to

² The means-oriented basis for taking action was positively correlated with the attitude toward outsiders based on partnerships.

Table 3. Coding structure and exemplary decision events

Empirical indicators	Exemplary decision events
Effectuation/basis for taking action: means oriented	
<ul style="list-style-type: none"> • Building on own knowledge base and other available existing own resources (including employees and material resources). • Defining only rough visions while leaving the details open. • Using infrastructure of local environment and technological know-how available in environment. • Following personal preferences. • Building on existing network of contacts to identify/create opportunities (includes attracting employees). 	<p>SunCo founder uses the German factory to brand SunCo as a well-reputed German company (made in Germany), while actually being Dutch, and to generate international exposure. (SunCo, 2003)</p> <p>An eventual founder of SunCo sees his existing energy panel business threatened and imagines opportunities in solar energy. He explores different means and mini-projects to use solar and other 'green' sources, such as wind, solar-thermal, and PV. (SunCo, 1997)</p> <p>Founders of TextCo start with SMS services. To approach people, they collected phone numbers by going to nightclubs and talking to the customers. Subsequently, they sent text messages with a weekly nightclub agenda: the number of visitors increased, and they convinced the nightclub owners to pay for their service. (TextCo, 1999)</p> <p>Founders of TravelCo experience that the Internet becomes the preferred medium for people searching for passenger transport options, but the search for connectivity using multiple modes of transport is cumbersome and time intensive. When the founders meet, they soon decided to develop a business around this comparison. (TravelCo, 2007)</p> <p>WaterCo's founders decide to engage an existing contact to work full-time at WaterCo. This engineer, after working in a big chemical company, is also holding a patent in the field, which strengthens WaterCo's position in relation to a VC that shows interest. (WaterCo, 2001)</p>
Effectuation/attitude toward unexpected events: leverage	
<ul style="list-style-type: none"> • Accepting, gathering, and incorporating unexpected feedback, leading to changing paths of development. • Changing and adapting any potential plans made to accommodate unforeseen events. • Actively exposing company to outside influences, while being open minded. • Positively reacting to and incorporating unforeseen developments. 	<p>AppleCo launches a new apple type, but based on fruit breeders' complaints about the earlier concept, the concept is modified: anyone can buy trees to breed the apples on continental Europe, but in the U.K., New Zealand, and Australia, the club concept is upheld. (AppleCo, 2005)</p> <p>WaterCo ends up in a lawsuit with a huge competitor, and the founders decide to search for potential partners who want to commit themselves to this new situation and to start talking with the government about protection options. (WaterCo, 2004)</p> <p>The founders of TextCo realize they have missed out on the premium SMS market (e.g. TV shows). By coincidence, they run into a competitor in a hotel lobby and ask him to use TextCo technology to send premium SMS. (TextCo, 2006)</p> <p>DataCo founders change their focus based on changed circumstances: focus on fraud detection and money laundering based on perceived commercial opportunities in these sectors and earlier successful projects—this is also in response to 9/11 and accompanying legal changes. (DataCo, 2001)</p>
Effectuation/attitude toward outsiders: partnerships	
<ul style="list-style-type: none"> • Reaching trust-based flexible stakeholder agreements and commitments. • Cocreating business with stakeholders. • Engaging in stakeholder collaborations to pursue opportunities (while commitment extends beyond what they have agreed on earlier). • Exposing (draft) products to potential clients early on. 	<p>Following experiences in Germany and Belgium, SunCo removes wholesalers from the sales and distribution channel and engages directly in market creation with fitters (who receive information, training and promotional materials, and flexible contracts), which also gives them more options to maintain control in the fast-changing market. (SunCo, 2008)</p> <p>EnergyCo's founders decide to team up with local energy providers as joint venture partners to make local solar projects possible, as they needed the local funding possibilities of these partners. (EnergyCo, 1999)</p> <p>AppleCo's founders decide to cooperate in a large European project for disease resistance and the development of 'pre-breeding' genetic material for disease-resistant races. Cooperation is established through contacts at conferences within the fruit sector. (AppleCo, 2010)</p> <p>Founder of ChipCo starts talking to potential customers with only a draft of the product. He contacts Lucent, Nortel, and Cisco to find out how ChipCo's radical new product could be of value for them. They all want to see the real product first. (ChipCo, 2001)</p>

Table 3. Continued

Empirical indicators	Exemplary decision events
Effectuation/view of risk and resources: affordable loss	
<ul style="list-style-type: none"> • Being willing to make affordable personal sacrifices (including nonmonetary ones) for the best of the venture. 	The first phase of the company's life is financed by the founders, who also personally benefit from the state-run support program EXIST, offered in Germany to university, technology-based start-ups. (TravelCo, 2009)
<ul style="list-style-type: none"> • Finding unused resources in local environment (including subsidies). 	Although ChipCo's venture capitalist initially discouraged searching for subsidies ('if you need more money, ask us'), he now stimulates it as a way to acquire 'cheap money' because of the economical downturn. Founders decide to apply for a Dutch Government grant of €2 million for cooperation with a university. (ChipCo, 2001)
<ul style="list-style-type: none"> • Investing limited, small amounts of personal/company money, time, and effort. 	The founders of SunCo start to search for different (small) projects to apply solar panels. They view these projects as experiments to 'test the waters' in this volatile market. (SunCo, 2000)
<ul style="list-style-type: none"> • Managing growth expectations and ambitions. 	Because the technology development is very problematic and the economic situation is unfavorable and uncertain, SunCo announces that it will postpone the planned and announced large factory for thin film for at least 1.5 years. (SunCo, 2009)
<ul style="list-style-type: none"> • Limiting stakeholders' commitments to levels that are uncritical to them. 	Being approached by multiple investors, TextCo's founders decide not to attract external investments to finance a potential takeover of a competitor; they want to maintain control and not become dependent upon investors. (TextCo, 2007)
Causation/basis for taking action: goal oriented	
<ul style="list-style-type: none"> • Basing actions upon expectations (market, technology, policy trends) and predictions (of founders, board members, investors). 	TravelCo's founders do a detailed investigation of the German travel market, which revealed strong growth opportunities. Based upon this analysis, the founders decide to focus on the business-to-consumer (B2C) market. Of this, the most relevant target market is the Visiting Friends or Relatives (VFR) segment. (TravelCo, 2009)
<ul style="list-style-type: none"> • Defining and pursuing project goals, product, customer needs, or market goals (more specific than 'profit,' 'a better planet'). 	For each project, EnergyCo starts to prepare tailored and extensive financing plans in order to raise funding. (EnergyCo 1999)
<ul style="list-style-type: none"> • Defining and satisfying organizational needs (personnel, organization structure, infrastructure, technology, etc.) and selecting between options based on specific goals. 	EnergyCo is aware of the need for more sophisticated business development processes. The company's growth is suffering from a lack of systems with a negative impact on the speed of realizing projects. To try and correct this, one of the founders starts to work on the improvement of the information flow within EnergyCo and decides to implement an enterprise resource planning (ERP) system (for the second time). The goal of the ERP is to coordinate and optimize the usage of internal and external firm resources. (EnergyCo 2009)
<ul style="list-style-type: none"> • Evaluating planned progress and adapting means based upon feedback. 	To sustain projected growth, DataCo's founders decide that they need to increase capacity including the number of employees. To achieve this, a capital increase or industrial partner is considered. (DataCo, 2004)
<ul style="list-style-type: none"> • Searching and selecting contacts, clients and partners based upon predefined plans. 	Based upon months of planning and preparing, TextCo organizes a large (and expensive) mobile congress to attract media attention and potential new customers. (TextCo, 2009)
Causation/attitude toward unexpected events: avoid	
<ul style="list-style-type: none"> • Carefully interacting with environment for secrecy reasons (feel threatened by unexpected events, therefore work in isolation as much as possible). 	ChipCo's supply chain is organized in such a way that nobody except ChipCo knows the details of the production process: supplier of semiconductor material in Japan, the foundry in the U.S., further processing in the U.K., part of it to The Netherlands for testing, others to the U.S., and finally to Thailand for packaging. (ChipCo, 2001)
<ul style="list-style-type: none"> • Carrying out plans as defined in cases of unforeseen developments. 	As test results are disappointing, ChipCo's founders decide to double the test runs (of €100,000 each) to keep on track with product development and increase the yield of the process. (ChipCo, 2002)
<ul style="list-style-type: none"> • In cases of unforeseen developments, focusing on activities within the firm rather than engaging in interactions with the environment. 	After a few failed prototypes, the product development team of NeuroCo focuses on developing their own ideas of the best product, without interacting with the potential client. The software turned out not to offer extra value (because the NeuroCo software is high dimensional; for the medical application only 10 dimensions or so were needed). (NeuroCo, 2000)
<ul style="list-style-type: none"> • Drawing back from project or quickly resolving in cases of unforeseen developments. 	Buy out of one of the founders of AppleCo due to disagreements between the shareholders; no cooperation with his tree nursery any more from this point on. (AppleCo, 2008)

Table 3. Continued

Empirical indicators	Exemplary decision events
Causation/attitude toward outsiders: competitive analysis	
<ul style="list-style-type: none"> Acquiring resources through market transactions or contract-based agreements with stakeholders. Creating and carrying out patent strategy. Carrying out competitor analysis and competitive positioning. Carrying out systematic market research activities. 	<p>The main providers in the German market are covered by a partnership agreement. (TravelCo, 2008)</p> <p>To protect WaterCo's technology, the founders file their first patent. (WaterCo, 2000)</p> <p>Founders of DataCo focus on writing a second business plan. This was done to attract new investors as well as to make a mapping of where DataCo was heading, how the founders could best organize the organization to be better aligned with its new market segment, and to strategically position the company compared to competitors. (DataCo, 2001)</p> <p>TravelCo's founders do an extensive market analysis and find out that by 2009, the European online booking market is expected to be worth about €60 billion, of which €39 billion would be spent on passenger traffic. Of this, about €2 billion would represent commission-based sales. They select this as the target market for their Web site. (TravelCo, 2009)</p>
Causation/view of risk and resources: expected returns	
<ul style="list-style-type: none"> Maximizing personal profit. Calculating and evaluating expected outcomes/returns. Planning development in big steps and with large sums (including large recruitments) (large: relative for company). Postponing stakeholder (including clients) contact at the expense of own funds (focus on internal development). Searching for stakeholders to commit the amounts necessary for the execution of the plan. 	<p>Although there is no clear business plan yet, the founders of ChipCo start and get paid by the VC investments. They have high salaries to compensate for the risks they take. (ChipCo, 2001)</p> <p>Reorientation of NeuroCo apparently is too late; to avoid bankruptcy, either a merger or liquidation are considered. The decision is made based on the question of how high the losses are. They decide not to go immediately for bankruptcy, but to use the remaining capital to pay employees and leave everything in good order. (NeuroCo, 2002)</p> <p>To secure the planned investment of €3 million, the founders put €150,000 in patents and money into the company. (WaterCo, 2002)</p> <p>NeuroCo's founders focus on internal development of their own software using the collected funding, rather than by engaging with customers who could pay for it. (NeuroCo, 2000)</p> <p>Founders of DataCo actively search for new large amounts of capital from funds and/or investors by engaging in a roadshow, presentations, etc. (DataCo, 2001)</p>

Table 4. Analysis of cross-case variation

Case	Market	Experience	Number of effectuation dimensions coded	Number of causation dimensions coded	Difference # effectuation and # causation dimensions coded
SunCo	Existing	High	57	40	17
ChipCo	Existing	Moderate	36	41	-5
TextCo	New	Low	37	34	3
DataCo	New	Low	43	36	7
NeuroCo	Existing	Moderate	24	43	-19
AppleCo	Both	High	26	37	-11
EnergyCo	New	Low	38	44	-6
WaterCo	Existing	Low	20	35	-15
TravelCo	New	Moderate	23	31	-8
Averages	New		35.3	36.3	-1.0
	Existing		34.3	39.8	-5.5
		High	41.5	38.5	3.0
		Moderate	27.7	38.3	-10.6
		Low	34.5	37.3	-2.8

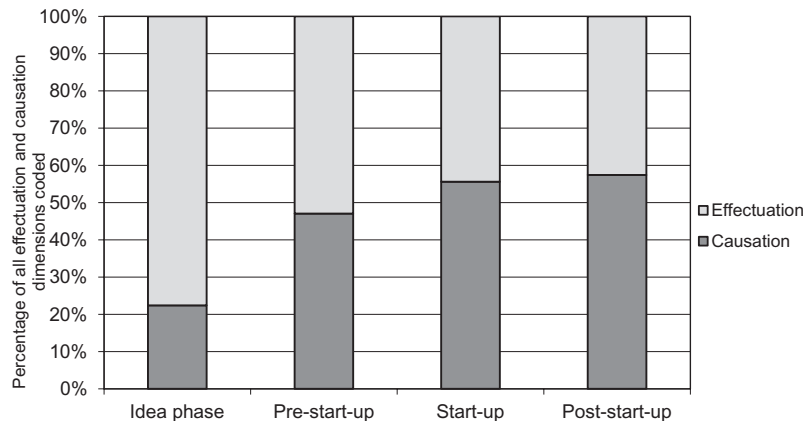


Figure 1. Percentage of effectuation and causation dimensions coded over all cases and per venture creation phase

important initial conditions that have been identified in prior research: level of uncertainty (e.g., Sarasvathy, 2008; Brettel *et al.*, 2012) and level of entrepreneurial experience (e.g., Dew *et al.*, 2009; Politis *et al.*, 2012).

Key sources of uncertainty are the novelty of the venture's technology and the novelty of the market (e.g., Sarasvathy, 2001). All cases offered new products and/or services based on new technologies, yet they differed with regard to the novelty of the market: three cases addressed an existing market and five cases addressed a new market (the ninth case targeted both an existing market and a new market). Comparing cases targeting an existing versus a new market showed no significant difference in the use of effectuation and causation (Table 4), using a Kruskal-Wallis test. In both types of cases, causation was used more frequently than effectuation (on average 1.0 more causation dimension coded for the cases targeting new markets and 5.5 more for the cases targeting existing markets). Similarly, we found no significant differences (using the Kruskal-Wallis test) in the use of effectuation and causation comparing the cases where the founders had high, moderate, and low levels of entrepreneurial experience (Table 4).

To investigate *within-case variation*, we first examined the overall use of effectual and causal decision making over the course of the venture creation phases. Figure 1 shows the relative frequency of the use of effectuation and causation across all cases; Figure 2 displays the same information per case. Overall, entrepreneurs used effectuation most dominantly in the idea phase (see Figure 1). Figure 2 reveals that effectuation is dominant in the idea phase in all cases, with the exception of SunCo (in

which causation dominates).³ Causal decision making becomes increasingly important in the later development phases for all cases, while the use of effectuation is decreasing (see Figure 1).

This initial exploration showed a clear pattern in within-case variation that is rather stable across cases, whereas exploring cross-case variation revealed no clear patterns. Within-case analysis demonstrated that, overall, effectuation is more dominant in the early phases, whereas causation is more dominant in later stages. In contrast, the analysis of cross-case variation showed that the initial conditions—i.e., the level of uncertainty and experience—are not systematically associated with differences in the overall use of effectuation and causation across our cases. This does not imply that these initial conditions have no effect, but it confirms that the investigation of within-case variation over time is a particularly promising analytical route to advancing our understanding of the use of decision-making logics in venture creation. Differences between cases may emerge from what occurs during venture creation more than from initial conditions.

Detailed temporal patterns in effectuation and causation

To further investigate within-case variation, we created event sequence graphs for each case

³ SunCo had two founders with different decision-making styles working on different projects. One founder focused on experimentally creating new markets for inventive solar systems using existing technology, while the other founder—who was dominant at the start—focused on a large, causally planned technology development project to create radically new solar cell systems.

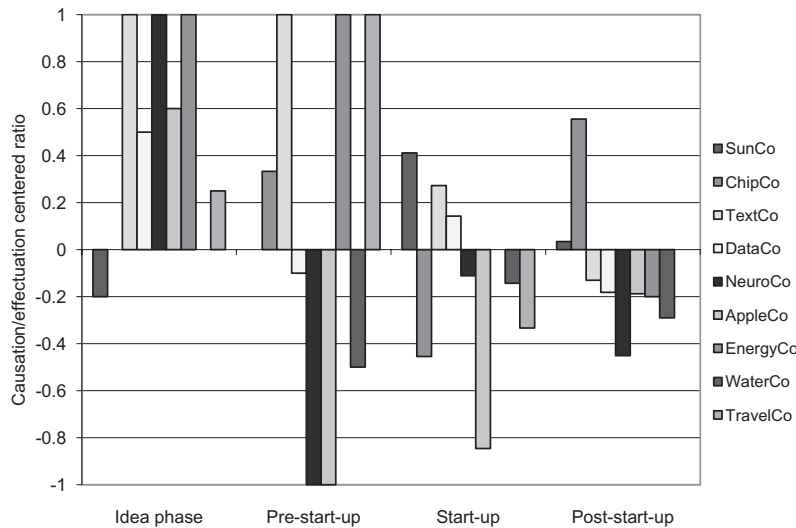


Figure 2. Distribution of effectuation and causation dimensions coded per case and per venture creation phase
Note: '0' means that the amount of effectual decisions equals the amount of causal decisions; >0: dominance of effectual decisions; <0: dominance of causal decisions.

(Figure 3). We calculated the moving average of the number of effectuation and causation dimensions coded per decision event for each case: for the first 10 decision events, we calculated the average of the number of effectuation and causation dimensions up to the decision event (for example, the moving average for causation at decision event 4 consists of the sum of the number of causation dimensions for decision events 1, 2, 3, and 4, divided by four). For the later decision events, we averaged the codes across the last 10 decision events. For example, if for a venture, the coding of decision events 11 to 20 resulted in a total number of 15 effectuation dimensions, its moving average for effectuation at decision event 20 is 1.5. These calculations resulted in event sequence graphs (Figure 3) showing the moving average of effectuation and causation codes (on the Y-axis) over the creation of the venture (events on the X-axis). For each case, the graphs show how the use of effectuation and causation logics evolves over time.

The event sequence graphs in Figure 3 show 'bumpy' patterns, with many small and big shifts in the relative dominance of effectuation and causation throughout venture creation, instead of a monotonic decrease of effectuation and increase of causation. Figure 3 also shows an *increase* in effectuation later in the venture creation process for SunCo, ChipCo, TextCo, NeuroCo, WaterCo, and TravelCo. Thus, underlying the overall pattern of more effectuation in

earlier phases shifting to more causation in later phases, the cases show more detailed dynamics: the dominant decision-making logic shifts several times per case. We now use a more inductive approach to explore what drives these shifts in the use of effectual and causal logics.

Turning points, scoping decisions, and their underlying conditions

Turning points

To understand the dynamics in the use of effectual and causal logic within the creation of each venture, we first identified the main turning points in the event sequence graphs (Figure 3 and Table 5) and then explored what led to these turns. Turning points are points in the graphs where substantial or 'large' changes in the direction of the curves take place. This is in line with Lichtenstein, Dooley, and Lumpkin (2006: 163), who define 'a change point' as 'the moment in a time series when the associated variable undergoes a shift in its mean or variance.' We operationalized this as the points where the moving average—for effectuation or causation—increases or decreases by 0.5 or more within five decision events. For example, for SunCo, we see a turning point at decision event 12, where an increasing trend in the use of effectuation turned into a decreasing trend (decreasing by 0.5 from 1.7 at

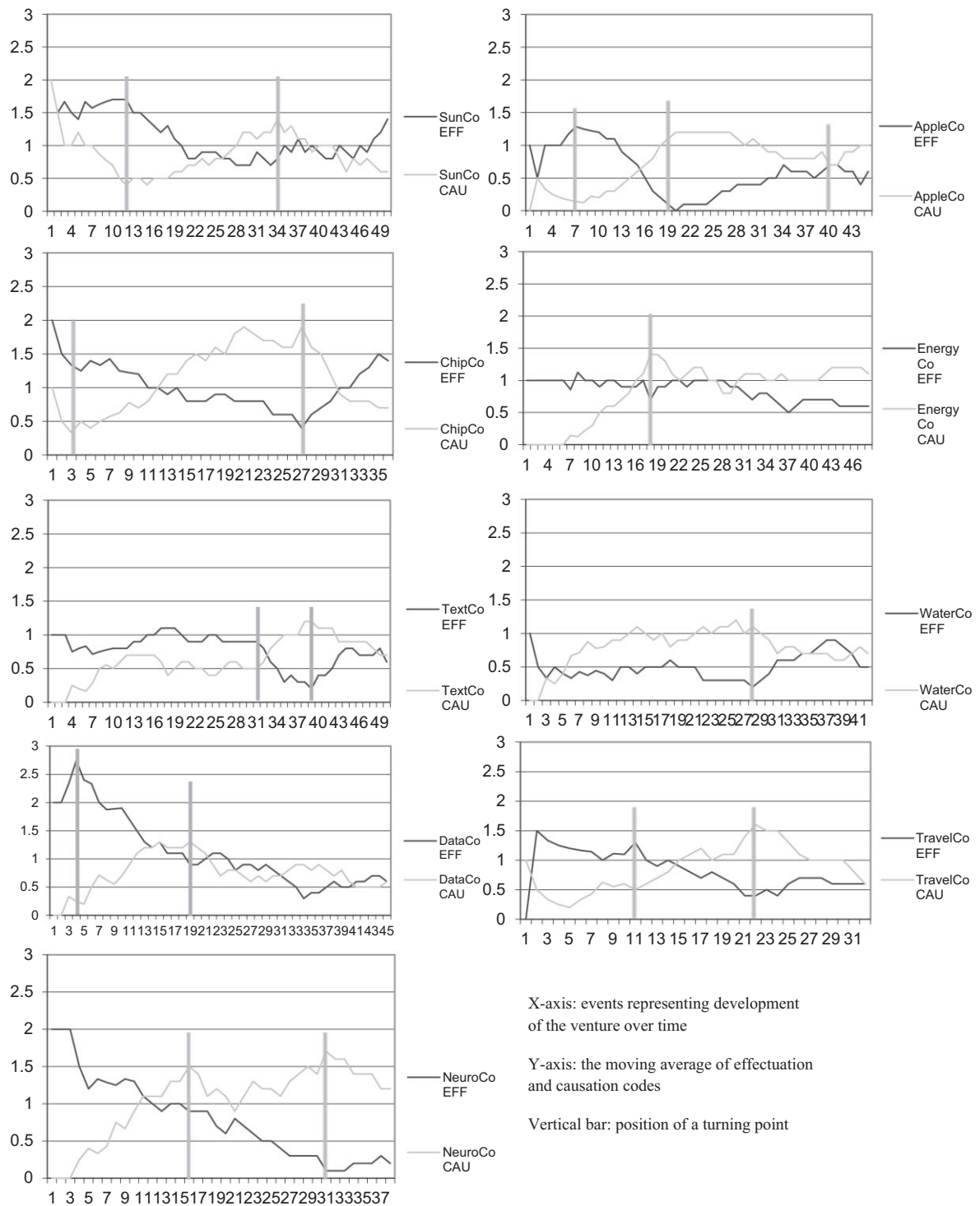


Figure 3. Event sequence graphs per case (with turning points)

Table 5. Analysis of turning points

Case	Turning point	Main condition (development preceding turning point)	Scoping decision	Shifts in the use of effectuation and causation
SunCo	12	<i>Low perceived environmental uncertainty:</i> By exploring information about possible technologies, the founders decreased uncertainty on technological possibilities. 'And then you start to delve into the technologies . . . and see all these technologies passing by and then you evaluate them.'	<i>Narrowing scope:</i> Focus on one technology. 'The main owner had visionary thoughts that this could become something. He said 'this is what I will do; this is my project. I am going to invest a lot of money because I believe in it.' '	<i>Effectuation decreases, causation increases:</i> Goal-directed decisions to attract people, protect IP, etc. 'For [new technology] development, someone from outside the company was hired to lead this project . . . Very much has been invested in development activities, really ridiculous . . . But for the [main] owner, that was just worth it.'
	34	<i>Low perceived resource position of the venture:</i> Cash flow problems due to economic crises and subsequent drop in market demand. 'There were days [in 2008] where we had just €0 to our bank account.'	<i>Widening scope:</i> Decision to explore alternative income and decreased costs. 'We said 'how can we generate more cash, because we won't get it from the bank.' So, we considered what we [could] do at the supply and the demand side. . . . We looked at how we [could] decrease our operational costs.'	<i>Effectuation increases, causation decreases:</i> Exploration of creative and flexible solutions, such as postponing payments, asking for prepayments, breaking up existing contracts, setting up a joint venture, etc. 'I looked at the most important suppliers. We instantly started (re)negotiations. We also opened up some long-term contracts.'
ChipCo	3	<i>High perceived stakeholder pressures:</i> VC wants focus on specific technology and market (holy grail). 'The technology is about monolithic integration of optical components. This is regarded as the holy grail. [The VC investor] said 'we are willing to invest €2 million in your private company and you should just start with it.'	<i>Narrowing scope:</i> Decision to start ChipCo, focus on specific technology. 'They started to further develop the technology. We had a plan to use the €2 million to construct the basis of the venture and to have another financing round within nine months to proceed with the development.'	<i>Effectuation decreases, causation increases:</i> Attracting more money, arranging IP, attracting experienced people. 'We made a plan and [prepared an] investor pitch; we visited 25 to 30 parties to see who was interested, and then tried to come to a deal.'
	27	<i>Low perceived resource position of the venture:</i> The venture ran out of money and was not able to attract more. 'Meanwhile we burned all our money and we needed a new financing round. At the same time, the market collapsed . . . The investors answered similarly: what you do is very exciting, but not now.'	<i>Widening scope:</i> Decision to explore alternative markets. 'Certainly, when the telecom market collapsed and our customers said 'not now,' we really started looking at alternatives. We looked at several possibilities to develop other applications.'	<i>Effectuation increases, causation decreases:</i> Development of prototypes for other markets as a reaction to unsuccessful previous focus. 'I think, basically, we tried all the options we had. We also made business cases for the military market and for this and that. I think we eventually just really tried all options.'
TextCo	31	<i>Low perceived resource position of the venture:</i> Incapability of the founders to manage the foreign office well from The Netherlands, and bad market conditions. 'But you cannot really have a business in another country without your full-time presence there. This is actually what I learned.'	<i>Narrowing scope:</i> Decision to close TextCo's foreign office and to focus on the domestic market. '[The foreign office] didn't bring us anything. We needed to get focused first. So we turned our focus 100% to The Netherlands and Belgium.'	<i>Effectuation decreases, causation increases:</i> Focus on the Dutch market by taking over other companies and developing services for another market (banking). 'I think around 2007, there were so many acquisitions. And then we participated: we went to competing companies that were willing to stop or which got other priorities and we asked 'Can we take over these activities?' We did that successfully twice.'
	39	<i>Low perceived resource position of the venture:</i> To attract the rest of the local market, they missed technological resources in terms of capabilities. 'There are always some customers who want something specific, which required us to push boundaries. For television, it was the peak volume of 30,000 messages per minute on a certain moment. Our system was completely unprepared for this. For the banks, we required continuous monitoring.'	<i>Widening scope:</i> Decision to expand technological capabilities for other sectors (producers for television, banks, police) (invest in hardware and software). 'There were some clients who kept us sharp . . . They came from competitors. We took them over, which was quite exciting, because they send five text messages almost every second during a day . . . It took us a lot of time to get it completely up and running.'	<i>Effectuation increases, causation decreases:</i> Explore a new business model, new products and services, and international markets. 'We make money with technology . . . Our technology unit is now much more involved in revenue share. We now develop technology for a customer in a certain country and do this for free, but we want 10% of the margin. We succeeded several times to make a lot of money with this model . . . But these were big steps to take.'
DataCo	4	<i>Low perceived environmental uncertainty:</i> Collaboration in the health sector resulted in recognition of the commercial potential of developed technology. 'Through this collaboration, we discovered there really were a lot of potential applications out there.'	<i>Narrowing scope:</i> Targeted attempts to set up commercial business. First rough selection of market segments, including health. 'Professor X convinced us of important opportunities for application of our techniques in medicine. We brought together a consortium of doctors and started looking for research funds to develop this further.'	<i>Effectuation decreases, causation increases:</i> Subsequent developments display increased goal-directed decisions, such as attempts to transform contract research in commercial business and to license the software. 'We basically took a phone book and started calling up all potential customers.' 'We develop clear agreements on IPR with the university.'

Table 5. Continued

Case	Turning point	Main condition (development preceding turning point)	Scoping decision	Shifts in the use of effectuation and causation
Neuro-Co	19	<i>Low perceived resource position of the venture:</i> DataCo has difficulties in attracting staff members with required expertise. It simultaneously realizes that it is active in too many different markets, stretching resources even further. 'We just didn't succeed in attracting the right people.'	<i>Widening scope:</i> Look broadly to acquire the required human resources. 'We had to find other ways to recruit.' <i>Narrowing scope:</i> Focus on fewer market segments. 'We discontinued the sports activities.'	<i>Effectuation decreases, causation decreases:</i> Mobilizing informal networks to find competent employees and to find customers. Dropping sports market applications, rewriting business plan, and start of lengthy internal reorganization. 'We started to introduce more structure and to clarify the personnel members' responsibilities.'
	16	<i>High perceived stakeholder pressures:</i> Pushed to develop the 'holy grail' and generate high income based on founders' promise in this regard. 'Although the initial idea had been to develop solutions, the board said that if we wanted to be a software company, we had to focus on developing a product.'	<i>Narrowing scope:</i> More focus on development of software product than consulting. 'We reduced our engagement in consulting projects and focused purely on developing and commercializing the software product.'	<i>Effectuation decreases, causation decreases:</i> Work on the software development, combined with continued consulting projects (not related to their technology), as these were the only projects that generated income.
	31	<i>High perceived environmental uncertainty:</i> Uncertainty due to lack of sales and project success. 'Sales were not going as expected. It turned out that customers didn't really need such sophisticated software; they could do with Excel.'	<i>Widening scope:</i> Trying to sell customized solutions instead of developing a generic product. 'We decided not to spend the remaining capital on perfecting the generic software. Instead, we had to search for possible profitable applications.'	<i>Effectuation increases, causation decreases:</i> As a reaction to this lack of sales, more focus on clients' needs, less focus on developing the core software as a generic platform, project acquisition through network of contacts, and search for merger as possible solution. 'They abandoned all the fancy tools and just used the core technology. Instead of offering a standardized software product, they developed customized solutions.'
Apple-Co	7	<i>Low perceived environmental uncertainty:</i> Research has resulted in increased insight in opportunities for new apple varieties, which reduced uncertainty. 'The results were phenomenal . . . So, based on these results, he really believed that the consumer wanted new and better varieties and that we would be able to commercialize them.'	<i>Narrowing scope:</i> Start thinking of independent R&D entity focused on generating commercial products. 'Now we are both doing this in a very primitive way. Perhaps we should join forces and see what comes out of it; organize ourselves as a dedicated, commercial R&D center.'	<i>Effectuation decreases, causation increases:</i> Increase of causal logic toward goals. First project is executed, the business is further developed and focused, partners acquired in line with goals, further investment round, IP rights clarified, etc. 'We started talking to the technology transfer office and to potential investors to set up a commercial R&D center.' 'The IP rights were transferred from the university to AppleCo.'
	19	<i>Low perceived resource position of the venture/high stakeholder pressures:</i> Need for new investment leads to abandonment of focus on genetic modification of fruit, as this is not accepted by investors, and to replacement of the CEO. 'The fruit auctions, which were considered the most appropriate future investors, disapproved of the biotech orientation of AppleCo.'	<i>Widening scope:</i> Decision to focus less on biotech sector. 'A new business plan was developed with less focus on genetic modification. We opened up to traditional breeding techniques.'	<i>Effectuation increases, causation decreases:</i> Effectuation as a reaction to unforeseen market and investor reluctance: new idea codeveloped with new CEO, new partners, and new employees from the venture's informal network. 'Given the European reluctance toward genetically modified food and the difficulties we had in attracting investors, we decided to diversify our activities.'
	40	<i>Low perceived environmental uncertainty:</i> Substantial interest from fruit growers, which reduces uncertainty. 'We successfully launched our third apple variety in Europe and beyond.'	<i>Narrowing scope:</i> Research into non-income-generating business (disease resistance) abandoned, focus on core business (fruit quality). 'Research on disease resistance of apples diminished, as it gave very slow results and often came at the cost of fruit quality. We decided to focus instead on fruit quality.'	<i>Effectuation decreases, causation increases:</i> More causal logic to pursue goals: IP rights secured for core business, buy out of one of the founders due to disagreements over focus. 'We bought a range of patent rights which fit our business focus.'
EnergyCo	18	<i>High perceived environmental uncertainty:</i> Dependency on government decisions creates need to develop company to explore modes of diversification along the product lines and markets. 'This [regulation] is a structural risk of [company]. The company has tried to reduce the risk by expanding in international markets as well as by diversifying its portfolio.'	<i>Widening scope:</i> Project-by-project structure in one technology is being turned into a more diversified portfolio. 'A weakness that we [bank] see is the dependency from policy . . . Whereas [company] works against that with broadening its position around wind, biomass, and water power.'	<i>Effectuation remains stable, causation decreases:</i> Growing into a real company means developing the business by enlarging the existing portfolio. Focus turns from mere project management in one technology to a broader opportunity search. '[Company] chose to create joint ventures with municipal energy providers. These joint ventures offered them the opportunity to realize projects more easily by integrating local stakeholders into projects.'

Table 5. Continued

Case	Turning point	Main condition (development preceding turning point)	Scoping decision	Shifts in the use of effectuation and causation
Water-Co	28	<i>High perceived environmental uncertainty/low resource position:</i> Competitor addresses founders with plans for a major IP lawsuit that threatens the existence of the company. 'They [competitor] really put money to that. They procured our products through a dummy company, picked them to pieces, and prepared a big patent lawsuit.'	<i>Widening scope:</i> Leave plans for business operations and development behind and redirect the focus to crisis management in reaction to actions of competitors in the market. 'When we got sued, all the VCs that we were negotiating with jumped off. So we had to think of something new.'	<i>Effectuation increases, causation decreases:</i> They start collecting and checking a variety of options, finally looking for partners in order to find other ways to stay in business. 'For example, I just went to the ministry of economic affairs asking whether they could do something to keep the technology in the country.'
Travel-Co	11	<i>High perceived stakeholder pressure:</i> Business angel investors bring operational know-how to the venture and ask to define and realize business model. 'The investors committed to further investments if the business development went according to business plan forecast.'	<i>Narrowing scope:</i> Start carrying out market research for positioning. 'Strategically, our primary target market segment for was the business-to-consumer market.'	<i>Effectuation decreases, causation increases:</i> A clearer positioning allows to implement a business model, plan and close a strategic partnership and thereby grow their activities. '[We] compared existing travel services and offered information on the travel duration and cost of all relevant providers in Germany.'
	22	<i>High perceived environmental uncertainty:</i> The company is threatened by other start-ups, some of which are backed by large companies. 'Bearing in mind the risk that one of the big players may enter our market soon, maybe we should think about taking the extra money and going international while still keeping the remaining shares.'	<i>Widening scope:</i> Trying out alternative products and services, also internationally. 'Selling software and software services to intermediaries . . . could be a source of revenue for us. For this area we could use the know-how, so I could imagine that to become a major business in the future.'	<i>Effectuation increases, causation decreases:</i> They try out different products, always asking what else can be done with marketing partners, what else can be done with software, where else they can go. 'Despite the existing indirect competition between [competitor/partner] and [company] the two organizations entered into a partnership: [competitor/partner] providing data for [company].'

decision event 12 to 1.2 at decision event 17). We identified 17 turning points across all cases.⁴

For each turning point, we then analyzed how the shift in decision-making logics occurred. Table 5 contains this detailed analysis for each turning point. We noticed a key phenomenon: shifts in decision-making logics emerged after entrepreneurs decided to change the scope of the ventures' activities (Table 5, column 'scoping decision'). We define the scope of a venture as the set of technologies, product offerings, or markets that the entrepreneurs consider or target at a particular moment in time. Most turning points were related to significant decisions about the set of technologies, products, and or markets considered: narrowing their

scope (tightened focus) or widening their scope (expanding options). For example, TextCo's founders, preceding turning point 31, *narrowed* the venture's scope by focusing on the domestic market, after having set up a foreign office (see Table 5). As one of the founders of TextCo recalls:

'[The foreign office] didn't bring us anything. We needed to get focused first. So we turned our focus 100 percent to The Netherlands and Belgium.'

At turning point 39, the entrepreneurial team of TextCo *widened* its scope by expanding technological capabilities for serving new sectors (e.g., television, banks). As one of the founders indicated, they were missing important technological capabilities at the time:

'There are always some customers who want something specific, which required us to push boundaries. For television, it was the peak volume of at one time 30,000 messages per minute. Our system was completely unprepared for this. For the banks, we required continuous monitoring, all day and night, as it should always work . . . It took us a lot of time to get it completely up and running.'

⁴ We performed several robustness checks for how we identified the turning points by calculating and plotting the moving average over 20 and five instead of 10 events and by defining turning points as increases or decreases of 0.3 and 0.7 instead of 0.5 within five events. We also analyzed turning points derived from alternative graphs, representing the total number of effectuation codes minus the total number of causation codes per event; and the moving average of the total number of effectuation codes over 10 events minus the moving average of total number of causation codes over 10 events. All analyses indicated that our results were stable.

Scoping decisions

Scoping emerged as a key influence on the subsequent use of effectual and causal decision making in the turning point analyses. Table 5 provides details on each scoping decision and the related shift in the use of effectuation and causation (columns ‘scoping decision’ and ‘shifts in the use of effectuation and causation’). *Widening* the scope mostly led to an increase in the use of effectuation and a decrease in the use of causation. It refers to a decision that involves exploring alternative technologies, products, or markets. To develop a broader scope, the entrepreneurs decide to explore options that can be created with their available means, for instance by exploring which alternative application fields or markets can be developed with their current technology. Hence, this process of widening the scope precedes the observed increase of effectual logic, while the use of causal logic decreases, as no specific goal is yet pursued in these explorations. The ChipCo case illustrates how a decision to widen the scope is associated with an increase in effectuation (see also Table 5). After having focused on a specific technology and market for almost three years and using causation as its dominant logic, ChipCo’s founders (in decision event 27) started to explore alternative markets for other applications of their technological capabilities (e.g., military, supercomputer, remote sensing, and the oil and gas industry); they followed the effectual logic of focusing on their means rather the preset goals. Effectuation even became the dominant logic in the post-start-up phase (see Figure 2). One of ChipCo’s owners reflected on the moment of broadening the company’s scope from one product to a range of possibilities:

‘... we really started looking at alternatives. We looked at several possibilities to develop other applications ... I think, basically we tried all the options we had. We also made business cases for the military market and for this and that. I think we eventually just really tried all options.’

This event demonstrates how ChipCo’s causal approach disappointed in the end and was replaced by effectual decisions reflecting experimentation with new products and market strategies based on existing technology as well as attempts to leverage existing contacts to generate new customers and business partners.

By contrast, *narrowing* the venture’s scope led to more causation and a decrease in the use of

effectuation. When narrowing the scope, the entrepreneurs focused on a specific set of technologies or products/services or on a specific market. A decision to focus enabled entrepreneurial teams to formulate goals, and subsequent efforts were targeted at selecting and attracting the means to reach that goal: attracting people with the required expertise, protecting IP, goal directed take-over of companies, developing new services for a new market, implementing a new business model or plan, and closing a new partnership. These goal-directed activities, together with protective IP actions, explain the observed increase in causal logic and decrease in effectual logic. An example of narrowing scope associated with increased causation can be found in the SunCo case. At decision event 12, SunCo’s founders narrowed their scope, stopped experimenting, and selected one specific technology to develop further. From that moment on, the use of effectual logic decreased and causation increased. The main founder of the venture took many goal-oriented decisions to protect intellectual capital and to hire external personnel that fit the venture’s reinforced focus on one specific technology. As the other founder recounted:

‘The main owner ... said ‘this is what I will do, this is my project. I am going to invest a lot of money because I believe in it’ ... For development, someone from outside the company was hired to lead this project [focused on one technology]. Very much has been invested in these development activities ... Compared to other companies, it is really ridiculous.’

Scoping decisions were, thus, identified as underlying the increase and decrease of effectuation and causation at turning points. The explanations were similar for all cases, and scoping decisions were found in all cases. Table 5 provides further examples.

Underlying conditions

The role of scoping decisions as immediate conditions influencing the use of effectuation and causation was surprising. Based on the literature, we would have expected perceived uncertainty to be a key condition. Thus, we next investigated in more detail what triggered scoping decisions at each of the 17 turning points in our ventures’ creation trajectories. First, the coauthors worked in three teams

and independently inspected three cases each to compile an initial list of potential conditions. Second, the lists of potential conditions were compared and discussed across the nine cases until a set of final conditions was determined. Third, the resulting list of conditions was used to analyze all turning points. The researchers discussed issues that emerged during this analysis until consensus was achieved. The results of this analysis are displayed in Table 5, in the column ‘main condition.’

Decisions to change the scope were influenced by developments internal and external to the venture. We discerned three types of such developments as necessary to lead to changes in venture scope. First, changes in the entrepreneurial teams’ *perception of environmental uncertainty* (e.g., uncertainty about the market) lead to changes in venture scoping. Increases in perceived uncertainty lead to decisions to widen the scope and the exploration of alternative options to deal with this increased uncertainty, as illustrated at turning point 31 in NeuroCo. One of NeuroCo’s founders noted that:

‘Sales were not going as expected. It turned out that customers didn’t really need such sophisticated software; they could do with Excel . . . We decided not to spend the remaining capital on perfecting the generic software. Instead, we had to search for possible profitable applications.’

Decreases in perceived uncertainty, however, result in narrowing the scope. For example, decreased uncertainty in technological or commercial possibilities enables entrepreneurial teams to focus on a specific technology or market. In the case of DataCo, a collaboration in the health care sector provided evidence for the commercial potential of applications in that sector. As explained by one of DataCo’s founders:

‘Through this collaboration, we discovered there really were a lot of potential applications out there [i.e., out in the medical sector].’

As a result, the founders narrowed the venture’s scope at turning point 4, when they made the first rough selection of market segment, of which the health sector was one.

Second, changes in entrepreneurial teams’ *perception of the resource position* of the venture influenced venture scoping: a meager resource position—either in terms of financial or human resources—led

to widening the scope.⁵ In the SunCo case, financial problems at turning point 34 drove the entrepreneurs to explore alternative income streams and new ways of keeping costs under control. As one of SunCo’s founders recalled:

‘There were days where we had just €0 on our bank account . . . We said ‘how can we generate more cash, because we won’t get it from the bank.’ So, we considered what we can do at the supply and the demand side.’

Entrepreneurs seemed to believe that by broadly scanning many options simultaneously they would find some opportunity that might help them get out of their misery.

Third, changes in entrepreneurial teams’ *perceptions of pressures from stakeholders* (such as investors) led to narrowing the scope of the venture.⁶ Stakeholders were often venture capitalist and angel investors who wanted the ventures to focus on a specific technology and markets and, thus, they pushed for the development of a new ‘holy grail’ technology to clearly position the business in the market. Given their dependent relationship, the entrepreneurs had to respond to these pressures and focus their ventures’ scopes as requested. As one of NeuroCo’s founders noted, concerning turning point 16:

‘Although the initial idea had been to develop solutions, the board said that, if we wanted to be a software company, we had to focus on developing a product.’

A DYNAMIC MODEL OF STRATEGIC DECISION MAKING IN VENTURE CREATION

We synthesize explanations for the observed dynamic patterns and the shifts in the use of decision-making logics over time in an integrated

⁵ The only exception is at turning point 31 of TextCo, where a low perceived resource position of the venture leads to narrowing the scope. Given the lack of human resources, they decided to focus on their current market from the main office instead of dividing their attention over two offices.

⁶ We observe one exception. For AppleCo, stakeholder pressures lead to widening the scope (at turning point 19). However, this exception can be explained by the simultaneously low resource position of the venture (our second condition leading to changes in venture scope), which is associated with widening the scope.

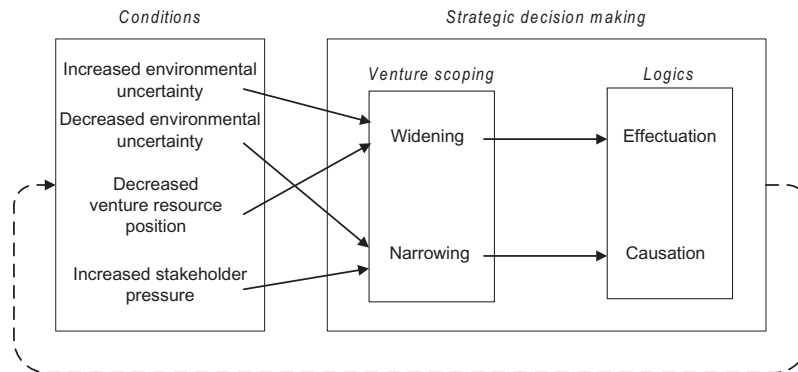


Figure 4. A dynamic model of strategic decision making in venture creation processes

dynamic model of strategic decision making in venture creation processes, displayed in Figure 4.

The shifts in decision-making logics are driven by strategic scoping decisions that determine the set of technologies, products, and markets venture founders consider at a certain moment in time. Narrowing the scope generally led to a decrease in effectuation and an increase in causation, while widening the venture's scope had the opposite effect. Scoping decisions, in turn, were triggered by perceived changes in external and venture conditions (uncertainty, resource position, and stakeholder pressure). Scoping decisions are, thus, part of an integrated explanation for dynamics in the use of effectuation and causation in venture creation processes. Our data further suggests that the use of effectuation and causation may lead to perceived changes in the external and venture conditions (represented by the outer arrow in Figure 4) which, in turn, impact strategic decisions on venture scope and thereby increase or decrease the use of effectual or causal decision making. To illustrate our integrated dynamic model of strategic decision making in venture creation processes, we use the example of AppleCo, focusing especially on the dynamics marked by three turning points (at decision events 7, 19, and 40).

Since 1982, the owner of an apple tree nursery and the research director of a university's fruit breeding center had jointly developed several new apple varieties. In 1997, the owner of the tree nursery conducted a very successful experiment (turning point 7): for the duration of the experiment, produce was delivered daily directly to a large supermarket chain (Delhaize). This allowed the owner to deliver high quality products and address consumers' wishes as

they arose (as opposed to the long, supply-driven fruit production chain normally in use). As explained by one of the founders:

'Through his [one of the founders] family business, he had contacts with Delhaize. They agreed to set up an experiment . . . The results were phenomenal. The total turnover of all apples in these Delhaize locations rose by 100 percent, the turnover for his own apple varieties rose by 300 percent, and the frequency of visits to these shops increased by 60 percent. So, based on these results, he really believed that the consumer wanted new and better varieties and that we would be able to commercialize them.'

This experiment reduced the founders' perceived uncertainty about market reactions, clarifying the environment and increasing the entrepreneurs' certainty about their capabilities and products. This decreased uncertainty, in turn, fed into the decision to narrow the scope toward generating commercial products. The founders started preparing the start-up of an independent R&D entity focused on commercializing a selection of 20 apple varieties generated over the previous 15 years of research. From that moment on, the use of effectual logic decreased and causation increased, as reflected in decisions on the financing and intellectual property rights of the venture. One of AppleCo's founders recounted:

'We dropped the concept of a research company and decided to become a commercial entity. We could not do this with project money anymore. It required serious investments and a broader technology and product portfolio. We toured the traditional investment circuit in search for money . . . We started up negotiations with Penn State University for the

exclusivity license on the use of self-fertilization in apples.'

By 2001, however, the commercial focus and accompanying causal decision making still had not generated any substantial revenues. AppleCo needed a new round of capital investment (turning point 19). This low perceived resource position led to a widening of the venture's scope. In particular, the founders abandoned their focus on genetic modification of fruit, as this was not well received by potential investors. As one AppleCo founder recalled:

'The fruit auctions, which were considered the most appropriate future investors, disapproved of the biotech orientation of AppleCo ... The negative public attitude toward genetically modified food was not going away.'

In order to alleviate their resource needs and acquire additional funding, the founders rethought their business plan and considered traditional breeding techniques. This widening of the venture's scope led to a decrease in causation and an increase in effectuation. In particular, the founders codeveloped the new business idea in collaboration with their new investors, as well as with new partners, employees, and even a new CEO, which all came from their informal network. As one founder recalled:

'We developed the new business plan together with our new CEO. He had a more mixed profile, with experience in both genetic and traditional breeding. He was already in our network, and he was interested in working with us and in developing the idea together.'

Over time, this effectual approach in which multiple options were envisaged—including genetic and traditional breeding as well as focusing on fruit quality and disease resistance—resulted in concrete information about consumers' desires and fruit growers' interests (at turning point 40). Fruit growers were interested in AppleCo's varieties, and it became evident that consumers were valuing the quality of fruit above the reduced need for pesticides. In other words, the effectual decision making resulted in reduced perceived environmental uncertainty. Consequently, the venture again narrowed its scope in 2005 by abandoning its research into disease resistance (which had not resulted in any marketable fruit variety) and focused purely on developing and commercializing varieties with improved fruit quality. One of the founders of AppleCo recounted:

'Research on disease resistance of apples diminished, as it gave very slow results and often came at the cost of fruit quality. As it turned out that consumers were valuing quality above buying a more environmentally friendly apple, and as the launch of the three existing high quality varieties was going well, we decided to focus instead on fruit quality.'

This renewed focus resulted in the use of more causal logic. The company searched for and secured intellectual property rights for its core business, and one of the founders was bought out due to disagreements on the venture's new scope. By 2010, however, it became clear that the launched apple varieties were not as successful as initially believed. Although initial market reaction had been positive, the company was not meeting its sales and revenue targets. The causal decisions, hence, led again to increases in uncertainty and investor pressures.

DISCUSSION

This longitudinal study investigated strategic entrepreneurial decision making during the venture creation process. We focused on recursive relations between strategic decision making and venture creation: strategic decisions shape a venture, and outcomes of such decisions in turn influence the external and venture conditions, which in turn affect the use of decision-making logics. This enabled us to advance understanding of dynamics of strategic decision making in the process of venture creation.

We advance theorizing on strategic decision making under uncertainty in three ways. First, we clarify the relationship between causal and effectual decision-making logics as examples of planning and flexible decision-making logics, respectively. We find that strategic entrepreneurial decision making follows a hybrid logic that uses both effectuation and causation simultaneously, while the dominant logic dynamically shifts over time. Second, our findings—synthesized in our dynamic model of entrepreneurial decision making—support and elaborate on the insights of Alvarez and Barney (2005) regarding the context dependence of entrepreneurial decision making for venture creation. In particular, they broaden our understanding of conditions and drivers of effectuation and causation beyond initial uncertainty and entrepreneurial experience. In addition to perceptions of uncertainty, we also identify resource position and stakeholder pressures as conditions influencing effectual and causal logics. Furthermore,

we find that these conditions do not mechanistically trigger entrepreneurs to use more or less effectuation and causation. By contrast, our analyses uncover the important, intermediary role of active entrepreneurial decisions on venture scope in response to external and venture conditions (perceived environmental uncertainty, resource position, and stakeholder pressure). Third, our findings more generally demonstrate that unique insights can be derived from process research on strategic decision making under uncertainty (on additional conditions influencing effectuation and causation, as well as mediating mechanisms) that are not available from cross-sectional research.

Hybrid decision-making logic

Our findings contribute to a better conceptual understanding of the relation between planning-based and flexible decision-making logics in general and the relation between causation and effectuation in particular. The findings indicate that entrepreneurial decision making is most commonly following a 'hybrid' logic that contains and combines elements of both effectuation and causation. Thus, our findings confirm expectations that effectual and causal logics are at work simultaneously (Dew *et al.*, 2011), and they contrast with studies treating effectuation and causation as mutually exclusive, opposing logics (e.g., Brettel *et al.*, 2012; Dew *et al.*, 2009).

We find that one of the logics may predominate at times, but that this emphasis on effectuation or causation is subject to shifts over the course of venture creation. This finding challenges studies that treat decision-making logics as stable tendencies, determined by founding conditions such as experience and uncertainty. The overall pattern that emerged from our analysis lends support to the expectation that flexible decision making is more prominent in the earlier stages of venture creation, with a transition to more planning-based decision making over time as both the new venture and its market mature (Alvarez and Barney, 2005; Sarasvathy, 2001). Yet, we also qualify this expectation: effectual decision making can reappear in later venture creation phases. Thus, effectuation and causation not only co-occur but also reoccur in different patterns over the venture creation process. Our dynamic model offers a novel explanation for these dynamics in decision-making logics in the venture creation process.

Conceptualizing entrepreneurial decision making as following hybrid logic has important implications

for the measurement of effectuation and causation. First, effectuation and causation should be measured independently using separate scales and coding schemes rather than presenting effectuation and causation as polar opposites. Second, our results suggest that both effectuation and causation may be best conceptualized as formative constructs at the event level. There were only very low to zero correlations among the dimensions underlying effectuation and causation, respectively. Chandler *et al.* (2011) similarly found effectuation to be a formative measure, but they did not find empirical evidence that this is also the case for causation. The fact that our results show that both effectuation and causation dimensions are relatively independent is probably a result of our fine-grained process approach of investigating decision-making logics within specific events, while Chandler *et al.* (2011) and others measured overall decision-making tendencies of individual entrepreneurs cross-sectionally.

Conditions influencing shifts in decision-making logic

Our findings deepen and widen our understanding of conditions stimulating effectuation and causation and thereby contribute to theory development on strategic decision making in venture creation processes. As Perry *et al.* (2012) highlight, the next stage of theory development in effectuation research requires researchers to build a better and more fine-grained understanding of the origins of effectuation. Our findings extend research to date that: (1) examines static conditions influencing strategic decision making such as entrepreneurial expertise (e.g., Dew *et al.*, 2009; Sarasvathy, 2001), which cannot explain shifts in the use of effectual and causal logic over time; or (2) focuses on uncertainty at founding (e.g., Wiltbank *et al.*, 2009; Read *et al.*, 2009a).

We highlight scoping decisions as central to our understanding of shifts between decision-making logics in venture creation processes. They serve as a way to discover or create opportunities (Alvarez and Barney, 2007). As such, the concept of scoping in this study is not so much related to the concept of 'economies of scope' as discussed in the strategic management literature (Teece, 1980; Levinthal and Wu, 2010), but more to the concept of 'search breadth' as a way to discover or create new opportunities (Klingebiel and Rammer, 2013). However, neither the strategic management literature nor evolutionary theory has systematically linked this

concept to decision-making logics. Recent work by Alvarez *et al.* (2013) and Andries *et al.* (2013) hints at a potential relationship between searching broadly for new opportunities and the use of effectual decision making. We make this relationship explicit by demonstrating that a decision to widen venture scope leads to an increase in the use of effectual decision making, such as flexibly leveraging contingencies at hand and creative experimentation. In contrast, narrowing venture scope leads to a causal logic of control aimed at greater efficiency.

We extend this thinking further by presenting evidence on what leads to changes in venture scoping, and, as a consequence, in decision-making logics. Our process study supports the theoretical argumentation by Alvarez and Barney (2005) that venture creation processes are characterized by changing levels of risk versus uncertainty and that these changes will require entrepreneurs to adjust their decision-making logic. In particular, and in line with past theorizing and research, our study highlights the importance of perceived uncertainty as a condition explaining shifts in the use of effectual and causal logic over time. However, we also uncover novel, time-varying conditions influencing shifts in decision-making logics including perceptions of resource position and stakeholder pressure. Taking account of these conditions (changes in perceived uncertainty, resource position, and stakeholder pressure) enables us to explain why we do not see a simple uniform development from effectuation to causation over time. Changes in these conditions can interrupt and ‘reset’ the suitability of decision-making logics through their impact on active venture scoping decisions. Thus, adopting a process approach helped build a more fine-grained understanding of influence mechanisms and a greater appreciation of the role of entrepreneurs’ agency in venture creation (see McMullen and Dimov, 2013).

Changes in venture resource position lead to changes in scope and, indirectly, to shifts in effectuation or causation. When resources are insufficient to continue with a venture creation path, entrepreneurs predominantly widen their ventures’ scopes, which subsequently leads to an increase in effectual decision making. This result extends earlier findings that resource constraints stimulate resourcefulness and lead to a search for creative solutions by using flexible decision-making logics (Baker and Nelson, 2005; Carter and Van Auken, 2005; Mosakowski, 2002). Interestingly, these findings are at odds with the more general observation of rigidity and narrow-

ing of focus and scope observed when larger organizations face resource constraints (cf. Staw, Sandelands, and Dutton, 1981; Kaul, 2012), suggesting that firm size may moderate the impact of resource positions.

We find that stakeholders such as investors often push for narrower rather than broader venture scope. Several explanations can be hypothesized. Our findings may illustrate that many investors are still convinced about the validity of a focused approach. They may regard a broad scope of activities as an indication of the entrepreneurs’ inability to ‘do their homework.’ Similarly, investors may not be supportive of changes in venture scope, questioning whether the initial technology, product, or market choice was wrong or whether the problems reflect inadequate execution by the venture’s founders (cf. Bhidé, 1992). Investors likely prefer a broad scope of activities at the level of their investment portfolio, rather than within each individual company. If at all, investors seem to accept widening the scope only as a last resort, a ‘fire-fighting’ or ‘emergency’ strategy to protect their endangered investments in individual ventures.

Our findings on scoping also advance the understanding of conditions for and consequences of scoping in the strategic management literature. This literature provides some basic insights in this respect, i.e., changes in corporate scope result from resource constraints, the firms’ technological innovations, or innovations introduced by competitors (Kaul, 2012; Levinthal and Wu, 2010). It also connects changes in scope and search breadth with performance outcomes and advocates that larger search breadth increases innovation performance (Klingebiel and Rammer, 2013). We add to this emerging literature in two ways. First, our findings highlight stakeholder pressure as an additional condition influencing scoping decisions. Second, our findings suggest an important pathway—shifts in strategic decision-making logics—through which scoping may ultimately impact firm performance. Thus, our findings may aid the building of more differentiated theoretical models on the consequences of scoping.

Practical implications

We show how a planning-based and a flexible decision-making logic are combined in real life. Because entrepreneurs commonly use a hybrid decision-making logic, the ability to shift between

the two logics emerges as a key entrepreneurial capability. Our dynamic model of strategic decision making in new venture creation processes can be used to stimulate practitioners to reflect about the conditions shaping venture scope, including the consequences of venture scope for using certain decision-making logics. Entrepreneurs may benefit from considering the fit of effectuation with a wider venture scope and causation with a narrower scope.

Taken together, our findings imply that entrepreneurship education should train and support both effectual and causal decision making: enabling entrepreneurs both to plan and to adapt, to work toward goals and to exploit means, to compete and to collaborate, and to calculate expected returns and to limit downside loss. It should also develop entrepreneurs' skills in judging when to use either approach, as well as their ability to combine both types of reasoning.

Limitations and suggestions for further research

A limitation of the current study is its reliance on retrospective data, which could impact the accuracy and completeness of data—in particular on earlier phases of the case histories. We took measures to limit retrospective bias, such as using both documents and interviews, focusing on significant decision events (Chell, 2004), utilizing event lists (Belli, 1998), and ensuring that decision events were mentioned by the founders and at least one other data source. In general, where retrospection affects data, it typically leads to more sanitized, rationalized versions of history (Schwenk, 1985) associated, in particular, with elements of causal decision making. Thus, we do not expect our key findings (effectual decision making in the earlier stages and multiple shifts in logics) to be explained as an effect of retrospection. Nevertheless, future research would benefit from documenting dynamics in real time.

While we found evidence for the hybrid use of effectual and causal decision-making logics, future research could clarify whether there may be certain decision areas that lend themselves particularly well to either effectual or causal decision making. Although we focused on technology ventures, as these are confronted with substantial uncertainty regarding technologies and markets, future studies should verify whether the same decision-making dynamics are present in ventures that are confronted with other types of uncertainty beyond technology. Furthermore, large corporations are increasingly

confronted with uncertainty, e.g., arising from new competitors in new markets or the increasing speed of development. Thus, future research may test our dynamic model of strategic decision making in a corporate context.

We also see opportunities for research exploring whether additional conditions—next to changes in perceived environmental uncertainty, venture resource position, and stakeholder pressure—lead to changes in venture scope, thereby complementing our model. Also, it needs to be noted that whereas the strength of process research is to identify necessary conditions, variance research is needed to determine whether the necessary conditions we identified are also sufficient conditions for change in the use of decision-making logics (Mohr, 1982).

To advance theory on decision-making processes in new venture creation processes under uncertainty, future research could also explore the consequences of hybrid decision-making logics and adaptive processes of venture scoping on venture type. Given that the use of these decision-making logics depends on the presence of uncertainty about the value of opportunities and residual rights, we might expect that these types of decision-making logics may also be associated with different types of entrepreneurial firms (Alvarez and Barney, 2005). We also hope to inspire future research that links shifts in the use of effectual and causal logics and their combination, to the speed and efficiency of venture creation processes, venture growth, survival, and profitability.

Finally, this study focused on effectual and causal decision-making logics as examples of planning and flexible decision-making approaches more generally. We suggest that the hybrid decision-making pattern uncovered in our study may well generalize to the interplay of planning and flexible decision-making approaches more generally, which often are similarly treated as mutually exclusive. Further research covering a broader range of decision-making approaches is warranted.

CONCLUSION

In sum, we extend research on decision making under uncertainty as an important element in the organizing process of entrepreneurial firms (Alvarez and Barney, 2005). By studying patterns in ventures' effectual and causal decision making in-depth and over time, we find that entrepreneurs typically employ hybrid decision-making logics, and shift

from one dominant decision-making logic to the other. We explain these shifts, highlighting the intermediary role of 'venture scoping.' An entrepreneur's narrow focus on a 'holy grail' leads to causal decision making, while a broad scope pursuing several options simultaneously leads to effectual decision making. We also enrich the understanding of conditions influencing the use of decision-making logics, identifying venture resource position and stakeholder pressure, in addition to uncertainty, as drivers of venture scoping.

ACKNOWLEDGEMENT

The data collection for this research project was enabled by a grant of the European Community (ENT/EFORCE).

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